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## AN IMAGE ALTERING DEVICE FOR AN IMAGE PRODUCING APPARATUS

### Technical Field

Generally speaking the present invention relates to digital cameras, and more specifically to a digital camera having a camera housing with an optical input, such as a lens or objective, an image capturing unit and a controller. The invention also relates to an image altering device, providing the camera with a panning and/or tilting functionality as well as a functionality for changing the system magnification in fixed steps.

### Background Art

Camera systems with a wide field of view capability have been in existence for several years. These systems are normally based upon a more or less complex optical system comprising lenses and/or mirrors. In U.S. Pat. No. 5,907,433 to Voigt et. al., a plurality of optical groups are rotatably mounted on a rotary assembly to allow one of the groups to be inserted into the optical path. By using different sets of optical elements a multi-field of view is achieved. One method to obtain panning and/or tilting functionality is described in U.S. Pat. No. 5,717,512 to Chmielewski, Jr. et. al., This invention uses two wide field of view cameras to determine the coordinates of an object, and from that information adjust a rotatable plane pan/tilt mirror to direct light reflected from the object to a narrow field of view camera. Another approach to achieve wide-angle imaging is described in U.S. Pat. No. 5,790,182 to St. Hilaire, where fixed concentric spherical mirrors are used to direct light from an object onto a CCD (Charge Coupled Device) array. By this arrangement the system

is capable of capturing an image spanning a 360 degree field of view. No provision is shown for varying the field of view of the device.

5                   **Summary of the Invention**

          An object of the present invention is to provide a digital camera with a variable field of view combined with a tilting and/or panning functionality, being able to cover a greater visual volume than a  
10   conventional panning and/or tilting camera. Furthermore, it is an object of the present invention to provide an image steering and magnification/reduction device (referred to as "image altering device" in the following), to be mounted externally on the digital  
15   camera, for providing an efficient way of altering the field of view as well as changing the direction of sight. Another object of the present invention is to provide a simple method and apparatus to filter the light reflected from an object.

20           In carrying out the above objects and other objects and features of the present invention, the digital camera is provided with an externally mounted image steering and magnification/reduction device comprising a rotary mirror with at least one side having  
25   a curved surface. The tilting mirror is rotated within a minor predefined angle with respect to the optical input of the camera to change the direction of sight and by a major predefined angle to alter the field of view or to insert a filter in the optical path.  
30   By using a mirror with a curved surface, for a given field of view, the absolute size and weight of the mirror can be reduced, thereby making it possible to increase the rotary speed of the mirror and thus improving the overall speed of which the direction of  
35   sight can be changed from a first to a second position.

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The digital camera also comprises a control unit and an externally mounted driving device for rotating the tilting mirror according to a control signal generated in the control unit.

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### **Brief Description of the Drawings**

A preferred embodiment of the present invention will now be described in more detail, reference being made to the accompanying drawings, in which:

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FIG 1 is a schematic block diagram of the overall structure of a digital camera and an image altering device according to the preferred embodiment,

FIG 2 is a first side view of the image altering device and the camera, to which it is mounted,

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FIG 3 is a second side view of the image altering device and the camera shown in FIG 2,

FIG 4 is a top view of the image altering device shown in FIGS 2 and 3,

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FIG 5 is a simplified schematic drawing of the main functional parts of the preferred embodiment, where the tilting mirror is positioned to achieve a wide field of view,

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FIG 6 is a simplified schematic drawing of the main functional parts of the preferred embodiment, where the mirror is positioned to achieve a narrower field of view, and

FIG 7 is a simplified schematic drawing of the main functional parts of a first alternative embodiment.

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### **Detailed Description of the Preferred Embodiments**

Referring first to FIG 1, a digital camera 300 is illustrated in a basic modular form. The digital camera 300 is arranged to produce one or several digi-

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tal image(s) of a generic object 100, which may be any physical object that is present in a volume optically covered by the digital camera 300. An inventive image altering device 200 is mounted externally to the digital camera 300 in front of an optical input 400 of the digital camera. The optical input 400 is a generally known lens or objective. The purpose of the image altering device 200 is to provide the digital camera 300 with a variable field of view in combination with panning and/or tilting functionality. A preferred embodiment of the image altering device 200 will be described in more detail with reference to FIGs 2-7.

As shown in FIG 1, the digital camera 300 further comprises an image capturing unit 500, which is provided with appropriate means for producing a digital image representative of the object 100. Preferably, the image capturing unit 500 comprises a CCD element (Charge Coupled Device), the internal structure of which is believed to be well-known to a man skilled in the art. The digital camera 300 also has a controller 600 for controlling the image capturing unit 500 as well as the external image altering device 200. The controller 600 is operatively connected not only to the device 200 and the unit 500 but also to a digital memory 700 for storing images captured by the image capturing unit 500. Furthermore, the digital camera 300 may comprise an image transforming unit 800, the purpose of which is to rotate the digital image to compensate for image rotating effects caused by the image altering device 200, when the field of view is panned or tilted. The image transforming unit 800 is responsive to an angle of rotation of the image altering device 200 with respect to the objective 400 and uses this angle of rotation when transforming the digital image to compensate for the current pan and/or tilt angle. To perform such image transforming, i.e. to

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The memory 700 may be implemented by any commercially available memory, such as an SRAM memory.

The pan and/or tilt angle of the digital camera 300, or more specifically the angle(s) by which the image altering device changes the field of view of the camera 300 with respect to a central axis of the objective 400, may be set and changed by a user of the camera by accessing the controller 600 through the network 900. Alternatively, the pan and/or tilt angle(s) may be controlled from a computer directly connected to the digital camera 300.

Referring now to FIGs 5 and 6, two simplified schematic drawings of the general mirror arrangement and mechanism for altering the image according to a preferred embodiment of the present invention is shown. The image producing apparatus comprises a camera housing 6 and an optical input 5, such as a generally known lens or objective, for producing a digital image representing an object located in the visual volume surrounding the image producing apparatus. The mirror arrangement of the image altering device is located on a base plate 8, externally mounted to the camera.

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A fixed mirror 4, mounted directly in front of the objective 5, turns the optical path 31 of the image producing apparatus 6, thereby making it possible to optically cover a volume in the direction of the optical center axis of the objective 5. In the absence of the fixed mirror 4, the rotary mounted tilting mirror 1 would have to be located in a position directly in

front of the objective 5 in order to be located in the optical path of the image producing apparatus. The tilting mirror 1 would then block a ray emerging from an object located in the direction of the optical center axis of the objective 5.

FIG 6 again shows the preferred embodiment, this time with the tilting mirror 1 turned over to achieve a wider field of view. Referring to the discussion above, due to the convex curvature of the mirror surface 3, the law of reflection states that rays of light originating from an object in the optical path of the image producing apparatus will, when they are reflected in a convex surface, diverge in such a way that the magnification of the system will be less than unity.

FIG 7 shows a simplified schematic drawing of a first alternative embodiment of the present invention. In this embodiment, the rotatably mounted tilting mirror 10 includes, in addition to the first plane surface 11 and the second curved surface 12, a third surface 13 with an optical characteristic different from the first plane surface 11 and/or the second curved surface 12. One conceivable function of this third surface could be to reduce certain spectral components of the reflected light, e.g. to act as a light balancing filter in an indoor environment or to attenuate colors outside the yellow spectral band (approx. 570 nm) to achieve a contrast enhancement. Another conceivable function of this third surface could be to reduce, without distortion, the amount of light reflected from a bright object, located in a highly illuminated environment; i.e. the third surface 13 will act as a gray filter and equally attenuate the spectral components of the reflected light. In this alternative embodiment, the fixed mirror 14, the objective 15, the camera housing 16, the driving device 17



1	15	Camera lens (alt. embodiment)
1	16	Camera housing (alt. embodiment)
1	17	Driving device (alt. embodiment)
1	18	Base plate (alt. embodiment)
2	19	Optical sensor
1	20	Timing belt tightener
1	21	Timing belt tightener
1	22	Belt wheel
1	23	Belt wheel
1	24	Timing belt
1	25	Timing belt
1	26	Guiding wheel
1	27	Mirror wheel
2	28	Fixing part
1	29	Bevel gear
1	30	Tilt shaft

The image altering device 200 has a mirror system, comprising a first fixed mirror 4 and a second tilting mirror 1. As previously mentioned with reference to FIGs 5 and 6, the tilting mirror 1 has a first plane surface 2 and a second curved surface 3. The fixed mirror 4 is mounted directly in front of the

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at least the following advantages:

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Simple pan/tilt control

Multiple fields of view

Filtering and/or other image altering possibilities

- 5 The present invention has been described above with reference to a preferred embodiment. However, other embodiments than the one disclosed herein are possible within the scope of the invention, as defined by the appended independent patent claims.

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